INFLUENCE OF RECORDING/PLAYBACK TECHNIQUE ON SUBJECTIVE RESPONSES

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Introduction Different techniques for recording and playback are used today when evaluating subjective response to sounds. Little is known on how the different techniques affect the subjective perception and overall response. One previous study found that for wind turbine noise, binaural playback is more natural and less unpleasant in comparison to mono playback [1]. The present study was carried out to investigate if there is a difference in subjective perception and response related to loudness, pleasantness and annoyance between mono recordings played back through a loudspeaker, and binaural recordings played back via headphones. To test this we used sounds that differed with respect to temporal and frequency characteristics as well as spatial characteristics, and we used different durations of exposure.

Methods *Subjects* Twelve paid volunteers (6 male and 6 female) aged between 18 and 30 participated in the experiments. Audiometric tests (according ISO 8253-1) ensured normal hearing within 15 dB at the octave band frequencies 125 Hz to 4 kHz and 20 dB at 8 kHz. For the audiometric test a Madsen Orbiter 922 audiometer (automatic mode - ascending method) was used.
Stimuli Three types of stimuli were used in the experiments: noise from road traffic (RT), noise from passenger train (T) and a low frequency ventilation noise (V). The stimuli included both steady (V) and non-steady (RT, T) noise. The signals were recorded with two different techniques: monophonic and binaural, and each noise was played back at 3 different levels (2 levels in Experiment 3). The recordings were done with a Harmonie 01 dB system using an artificial head [2] with G.R.A.S 40 AD microphones and Danish Pro Audio 4037 preamplifiers for the binaural recordings and a G.R.A.S 40 EN microphone for the monophonic recordings. The outdoor sounds (RT and T) were recorded simultaneously with the two techniques, however with a distance of 1.5 m (along the road/track) between the artificial head and the mono microphone to avoid mutual disturbance of the sound field. The indoor sound (V) was recorded during two periods, each with either the artificial head or the mono microphone in position. Use of the same position for the indoor recordings was necessary because of standing waves in the room, and the non-simultaneous recording was permissible because of the stationary character of the sound.
Exposure room and playback setup The experiments were carried out in a listening room, which conforms to the IEC 268-13 standard [3] that describes "an average living room" acoustically. The monophonic recordings were presented through a loudspeaker (Genelec 1031A/1094A) (technique ML), and the binaural recordings were presented through either circum-aural headphones (Beyerdynamics DT 900) (technique BH1) or headphones that were completely open and free of the ear (AKG K 1000) (technique BH2). The loudspeaker was hidden behind a curtain, and in all experimental sessions the subject was seated at a chair facing the curtain.
Evaluation methods In Experiment 1 loudness, pleasantness and annoyance was rated on 10 cm horizontal scales with verbal anchor points (Figure 1). The answers were given on an electronic tablet after each exposure and automatically stored on a computer. To explore the effect of

duration, ratings were carried out following exposures of either 5 seconds or 10 minutes (annoyance only following the 10-min. exposures). In Experiment 2 the method of paired comparisons was used to compare loudness and pleasantness between sounds recorded and played back (5 sec.) with the same technique and across techniques. Only ML and BH2 techniques were used in this experiment, since comparisons involving circum-aural headphones (BH1 technique) would require that the headphones were taken on or off between stimuli. Finally, in Experiment 3, while listening to each sound the subjects described the sound using a method of semantic description with answers given on bipolar scales.

Experimental design The study had a 3 (sounds) x 3 (sound levels) x 3 (exposure techniques) factorial design with repeated measures. In Experiment 1, duration was also included as a factor. The order of the techniques (ML, BH1 and BH2) was balanced between subjects, and the order of sounds and sound levels was randomised for each person and technique. Prior to the evaluations, the subjects listened to all sounds and also underwent a learning session. To measure subject reliability, the evaluations of loudness and pleasantness after short time durations were carried out twice. The longer duration exposure was carried out on a separate day, and during these exposures the subjects were reading a book with short stories.

				Response Method	**Evaluation**
Exp: 1	Exposure Technique	ML, BH1, BH2	Short duration-5 s	*Category scaling (unipolar)* *Pleasantness* not at all pleasant — very pleasant *Loudness* heard nothing — very loud	Degree of pleasantness and loudness
			Long duration-10 min	9 stimuli *Pleasantness* not at all pleasant — very pleasant *Loudness* heard nothing — very loud *Annoyance* not at all annoying — extremely annoying	Degree of pleasantness, loudness and annoyance
Exp:2		ML, BH2	Short duration	*Paired comparisons* 9 stimuli 36 pairs Based on a half matrix (identity and reverse pairs excluded) design	Degree of pleasantness and loudness
Exp:3		ML, BH1, BH2	Short duration	*Semantic description - bipolar* 3 stimuli * 2 levels = 6 stimuli	Semantic profiles

Fig 1 Schematic presentation of the sessions

Results Results will be presented at the conference.

Keywords: binaural recording, mono recording, loudspeaker, headphone, playback technique, subjective response, road traffic noise, train noise, ventilation noise.

References

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